

REPORT TO CONGRESS
ON ITEMS REQUIRED BY SEC. 19 OF
THE HELIUM STEWARDSHIP ACT OF 2013
PUBLIC LAW 113-40,
AS AUTHORIZED UNDER 50 U.S.C. 167
BY
THE SECRETARY OF THE INTERIOR
March 2016

Executive Summary

This report addresses the items required by Section 19 of the Helium Stewardship Act of 2013 (HSA) and 50 U.S.C. § 167q, which reads:

“In anticipation of the implementation of Phase D described in section 6(d), and not later than 2 years after the date of enactment of the Helium Stewardship Act of 2013, the Secretary (in consultation with the Secretary of Energy, the Secretary of Defense, the Director of the National Science Foundation, the Administrator of the National Aeronautics and Space Administration, the Director of the National Institutes of Health, and other agencies as appropriate) shall submit to Congress a report that provides for Federal users—

- “(1) an assessment of the consumption of, and projected demand for, crude and refined helium;*
- “(2) a description of a 20-year Federal strategy for securing access to helium;*
- “(3) a determination of a date prior to September 30, 2021, for the implementation of Phase D as described in section 6(d) that minimizes any potential supply disruptions for Federal users;*
- “(4) an assessment of the effects of increases in the price of refined helium and methods and policies for mitigating any determined effects; and*
- “(5) a description of a process for prioritization of uses that accounts for diminished availability of helium supplies that may occur over time.”*

The sections of this report correspond to the topics listed by Congress in Section 19 of the HSA. Section 1 of this report discusses in detail consumption and demand for refined helium by Federal agencies. Section 1 explains that Federal helium demand is expected to remain relatively flat during the period from 2015 through 2021. The demand projections for the next 20 years are also flat, but with each agency showing less confidence in the projections.

The 20-year strategy for securing access to helium is discussed in Section 2. After the helium program ends in 2021, Federal users will have to obtain their helium requirements from other sources. The acquisition strategy for Federal agencies is comprised of five parts: 1) Promulgating regulations to begin a Royalty-In-Kind program from helium extracted on Federal lands; 2) Exploring the Federal Strategic Sourcing Initiative as part of the Interagency Working Group to fully supply all Federal agencies and intramural contract holders; 3) Providing funding for conservation, recycling, and recapturing efforts; 4) Conducting an economic evaluation of options to continue a modified helium program beyond 2021; and 5) Forming an interagency working group to monitor the above mentioned strategies and suggest changes as the helium market evolves.

Section 3 provides for the determination of a date for the implementation of Phase D, the final phase in the transition process for the disposition of all interests held by the United States for the purpose of producing, refining, and marketing refined helium. The transition consists of four phases. Phase A—Allocation Transition—was completed in 2014 and Phase B—Auction Implementation—is in progress. Maximum production projections show that the recoverable, Federally-owned helium in the Cliffside

Field will reach 3.0 Bcf on October 1, 2019. Phase C begins when the Federal Helium Reserve declines to 3.0 Bcf, and lasts a minimum of two years. Therefore, according to current projections, Phase D can begin no earlier than September 30, 2021.

Sections 4 and 5 of this report address Congress's interest in the effects of increases in the price of refined helium, methods and policies for mitigating those effects, and a description of a process for prioritizing the uses of helium. Although future price projections are uncertain, the United States Department of the Interior (DOI) believes the 20-year strategy also mitigates the effects on Federal agencies of higher prices for refined helium in the private market and lessens the immediate need for prioritization of helium uses. However, the Bureau of Land Management (BLM) recommends forming an interagency working group to continuously assess the Federal helium needs, update helium demand and projections, and provide a process for prioritization of uses when necessary.

Table of Contents

Executive Summary.....	i
Federal Agency Acknowledgements.....	v
Terminology.....	vi
Definitions.....	vii
1 Consumption, Supply, and Projected Demand.....	1
1.1 Consumption and Uses (Federal and Commercial).....	1
Figure 1-Helium consumption, by end use, in the United States, 2008.....	1
Figure 2 - Helium recovery in the United States.....	2
1.2 In-Kind Program.....	2
Table 1 In-Kind helium transfers by Fiscal Year.....	3
1.3 Uses and Projected Demands.....	3
Table 2 - Total Helium-4 Demand Summary.....	3
1.3.1 NASA and DLA Uses.....	4
1.3.2 NASA and DLA Demand.....	5
1.3.3 Other Federal Uses/Demands.....	5
1.4 United States and World Production.....	6
Table 3 –World Production estimates.....	6
2 Twenty-Year Federal Acquisition Strategy.....	6
2.1 Royalty-In-Kind.....	7
2.2 Federal Strategic Sourcing.....	7
2.3 Conservation, Recycling, Reuse.....	8
2.4 Conduct Economic Evaluations of Options to Continue the Federal Helium Program.....	8
2.5 Interagency Working Group.....	9
3 Determination of Date Prior to September 30, 2021 for Phase D.....	9
4 Assessment of the Effects of Increases in the Price of Refined Helium and Mitigation Strategies.....	9
5 Prioritization of Uses.....	10
Appendix I Other Options and Strategies.....	1
1 Retool the Crude Helium Enrichment Unit (CHEU).....	1
2 Process helium from Cliffside at a nearby plant.....	1
3 Construct purification plant at Cliffside for Federal needs.....	2
Appendix II– History of Helium Program and Helium Supply Projections.....	1
1 History.....	1
2 Federal and Private Helium Supply Projections.....	2
2.1 From the Federal Helium Reserve.....	2
Table 4 – Forecasted production and sales.....	2
2.2 Federally-Owned Helium.....	3
2.3 Private Domestic Helium.....	3
Table 5 – Domestic Helium in the United States: 2009-2013.....	4
Appendix III– Acronyms Used in this Report.....	1

Federal Agency Acknowledgements

This report is the result of the combined effort of the DOI and several Federal agencies as required in the HSA. The DOI is thankful for the substantial assistance and contributions to this report provided by other Federal agencies. The following are recognized for their advice, assistance, and contributions:

Defense Logistics Agency

Ken Grams, Chief, Customer Operations
Aerospace Energy

Daniel Lerma, Chief, Customer Relationship Branch
Aerospace Energy

Douglas G Smith, Director, Supplier Operations
Aerospace Energy

Department of Defense

David A Cammarota
Office of Manufacturing and Industrial Base Policy
Office of the Undersecretary of Defense for Acquisition
Technology & Logistics

Department of Energy

Dr. Jehanne Gillo, Director
Facilities and Project Management Division
Office of Science for Nuclear Physics

Joel Grimm, Program Manager
Stable Isotopes and Accountable Material
Office of Science for Nuclear Physics

David Hardy, Major, USA, Ret., Senior Technology
Advisor
Advanced Manufacturing Office
Energy Efficiency and Renewable Energy

Other Department of Energy Contributors:

Dr. Bhima Sastri, Program Manager
Advanced Combustion
Office of Fossil Energy

Dr. Ramesh R Bhawe, Director, Inorganic Membrane
Technology Laboratory
Oak Ridge National Laboratory

Shirley Neff, Senior Advisor
US Energy Information Administration

Dr. Elisa Alonso, Materials Analyst
Nuclear Science and Engineering
Oak Ridge National Laboratory
Supporting Defense Logistics Agency
Strategic Materials

Executive Office of the President

Saul Gonzalez, Assistant Director for Physical Sciences
Office of Science and Technology Policy

Gerald C Blazey, Former Assistant Director for Physical
Sciences
Office of Science and Technology Policy

National Aeronautics and Space Administration

Thomas Elam, Helium Program Engineer
NASA Propellants Management

National Institutes of Health

Dr. Robert Tycko, Senior Investigator
Laboratory of Chemical Physics, NIDDK

Dr. Jeff Duyn, Investigator
Advanced MRI Section, NINDS

National Institute of Standards and Technology

Dr. Daniel C. Dender, Acquisition Specialist
Material Measurement Laboratory
NIST Center for Neutron Research

National Science Foundation

Dr. Crim Fleming, Assistant Director
Directorate for Mathematical & Physical Sciences

Dr. Daniele Finotello, Program Director
Materials Research Science & Eng. Centers
Division of Materials Research

Department of the Interior Contacts**Bureau of Land Management**

Karen Mouritsen, Deputy Assistant Director for Energy,
Minerals, and Realty Management

Timothy R. Spisak, Senior Advisor – Conventional
Energy, Minerals, and Realty Management

Sheila Mallory, Deputy State Director Minerals
New Mexico State Office

Robert Jolley, Field Manager
Amarillo Field Office

Adrienne Brumley, Petroleum Engineer,
Helium Lead
Minerals Division, New Mexico State Office

John Hamak, Lead Engineer
Helium Resources Evaluation,
Helium Resources Division, Amarillo Field Office

United States Geological Survey

Dr. Sean Brennan, Research Geologist
Eastern Energy Resource Science Center

Dr. Peter Warwick, Supervisory Research Geologist
Eastern Energy Resource Science Center

Terminology

(Please refer to Appendix III for a list of acronyms used in this report.)

With the enactment of the HSA, Congress assured continued operation of the Federal helium program, but with significant changes to its operation. The HSA seeks to mitigate helium shortages by enabling the sale of crude helium from the Federal Helium Reserve, increase taxpayer returns, and stimulate

investment in private helium sources by selling crude helium at market-driven prices. The HSA provides for an orderly transition in four phases:

Phase A, Allocation Transition: This Phase was a continuation of the Helium Privatization Act's sales volumes and conditions. This phase began upon passage of the HSA and ended on September 30, 2014.

Phase B, Auction Implementation: This phase began on October 1, 2014, and will end when the crude helium stored in the Federal Helium Reserve (exclusive of any private helium stored in the Cliffside Field and the helium originally contained in the reservoir) is reduced to 3 billion cubic feet (Bcf). During this phase, the BLM conducts auctions, which began in FY 2015. Each year the percent of helium in the reserve that is auctioned increases by at least 15 percent.

Phase C, Continued Access for Federal Users: This phase begins when the remaining crude helium stored in the Federal Helium Reserve is reduced to 3.0 Bcf and lasts a minimum of two years. The BLM would continue to provide crude helium for sale solely to Federal users. During this phase, there would be no sale or auction of helium to private entities, but there may still be deliveries to private entities of helium sold in Phase B. Current projections show that the recoverable, Federally-owned helium in the Cliffside Field may reach 3.0 Bcf by October 1, 2019.

Phase D, Disposal of Assets: In this phase, the Secretary of the Interior is required to dispose of assets by no later than September 30, 2021. These assets include all underground natural resources and the United States' rights to those assets.

Unlike the Helium Privatization Act of 1996, the HSA no longer requires the BLM to sell helium from the reserve in equal annual volumes. Sales can now match the amount available for production under each phase from the reserve.

Definitions:

Cliffside Field - The term 'Cliffside Field' means the helium storage reservoir in which the Federal Helium Reserve is stored.

Federal Helium Pipeline - The term 'Federal Helium Pipeline' means the Federally-owned pipeline system through which helium from the Federal Helium Reserve may be transported.

Federal Helium Reserve - The term 'Federal Helium Reserve' means helium reserves owned by the United States.

Federal Helium System - The term 'Federal Helium System' means the Federal Helium Reserve; the Cliffside Field; the Federal Helium Pipeline; and all other infrastructure owned, leased, or managed

under contract by the Secretary of the Interior for the storage, transportation, withdrawal, enrichment, purification, and management of helium.

Federal User - The term Federal User means a Federal agency or extramural holder of one or more Federal research grants using helium.

1 Consumption, Supply, and Projected Demand

1.1 Consumption and Uses (Federal and Commercial)

Federal helium use began as early as 1920 with the Navy's use of helium in blimps. By the late 1950s, helium was being used in greater volumes for welding of special metals for supersonic jets and rocketry. By 1960, the United States needed large amounts of helium for the space program. With the passage of the Helium Act of 1960, the mid-continent resources were developed and most of the recovered helium was stored in the Cliffside Field, which is located north of Amarillo, Texas, with nearly all of the remainder used by the National Aeronautics and Space Administration (NASA). Throughout the 1960s and 1970s, most Federal use was by NASA.

Beginning in the 1980s, NASA and the Department of Defense (DoD) accounted for most of the Federal helium used. However, multiple Federal agencies and researchers under Federal grants use helium in smaller amounts. Although the amounts they use are modest, their applications are important and provide a wide array of benefits to the United States. Figures 1 and 2 show helium uses and recovery (Federal and commercial) in the United States.

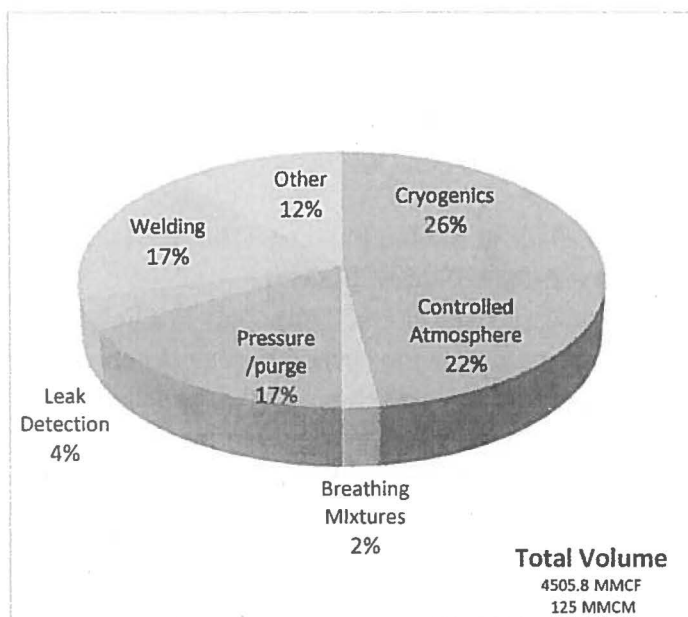


Figure 1-Helium consumption, by end use, in the United States, 2008

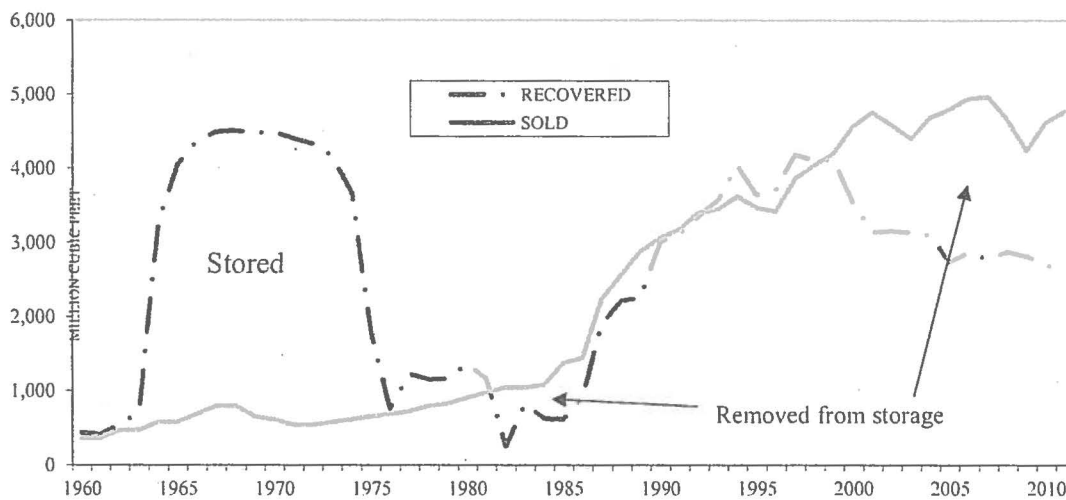


Figure 2 - Helium recovery in the United States (Recovered greater than Sold equates to net helium stored – Sold greater than Recovered equates to net helium removed from storage)

1.2 In-Kind Program

An important component of the BLM's helium program is the "In-Kind" program, which governs the sale of helium to Federal agencies that have major helium requirements for operations or research. Before passage of the Helium Privatization Act of 1996 (HPA), Congress required Federal agencies to purchase their refined helium supplies from the Department of the Interior's Bureau of Mines (BOM), which refined, sold, and delivered the helium to the Federal agencies. With the passage of the HPA and the abolishment of the BOM, which occurred separately, the BLM was given responsibility to manage the Federal Helium Program. The BLM then developed regulations (43 CFR 3195) to administer the In-Kind program. Under the regulations, private entities, known as Federal helium suppliers, who want to sell a major helium supply to a Federal agency, must enter into a contract with the BLM to purchase from the Federal Helium Reserve (FHR) an amount of crude helium equivalent to the amount of refined helium it has supplied to the Federal agency. These in-kind contracts authorize the private entity to supply refined helium through separate procurement contracts to Federal agencies, government contractors, and universities with certified Federal grant numbers. The supplied refined helium may originate from sources other than the FHR. Replenishment of helium volumes to the Federal helium suppliers to replace the helium provided to government users takes approximately 5 months to complete. The helium from the FHR is sold to the suppliers at a discounted rate compared to the open market rate. The discounted rate is intended to lower costs for Federal agencies and encourage participation in the In-Kind program.

In FY 2014, Federal agencies purchased \$6 million of helium through the In-Kind program. Table 1 shows the In-Kind helium transferred to Federal helium suppliers based on volumes reported by the suppliers and reconciled with the volumes reported by Federal agencies. The volumes have been decreasing for the past 5 years, but are expected to stabilize at approximately 150 million cubic feet per year (MMcf)/yr. The volumes have decreased in part because the NASA Space Shuttle Program

ended in 2011 and some Federal users were not able to procure helium for their research during a shortage that began about 2010 and ended around April 2014.

Table 1 In-Kind helium transfers by Fiscal Year

FY	Volume (MMcf)		FY	Volume (MMcf)
1998	48.9*		2006	179.3
1999	199.7		2007	200.0
2000	236.4		2008	209.9
2001	236.5		2009	175.3
2002	206.8		2010	170.6
2003	234.6		2011	164.9
2004	200.5		2012	153.4
2005	256.3		2013	146.3
			2014	82.7**
*The In-Kind program began in the last quarter of FY 1998				
**Two Agencies reported late, their volumes will be reflected in FY 2015 data				

1.3 Uses and Projected Demands

The two major Federal users of helium are NASA and the Defense Logistics Agency (DLA). The projected demands for those two agencies are discussed here. The demands and uses for small quantity Federal users and extramural contract holders are also discussed. Their uses include helium for medical and scientific research applications. The Federal demand information has been provided by the Department of Energy Isotope Program, which compiles demand information of stable and radio-isotopes for the Federal complex. Table 2 shows the latest projections of helium demand by Federal agencies.

Table 2 - Total Helium-4 Demand Summary

	Defense	NASA	Other	Total FY Demand
FY 15	32,313	86,841	35,291	154,444
FY 16	30,300	76,052	34,557	140,909
FY 17	29,006	85,359	34,799	149,163
FY 18	29,006	71,887	35,077	135,970
FY 19	29,006	81,286	34,829	145,120
FY 20	29,006	84,938	33,006	146,950
FY 21	29,006	84,938	32,290	146,233

FY 22	29,006	84,938	32,334	146,278
FY 23	29,006	84,938	32,747	146,690
FY 24	29,006	84,938	33,045	146,988
FY 25	29,006	84,938	33,203	147,146
Data compiled from US DOE FY2015 Federal Isotope Workshop Questionnaires, DOE Office of Science -- Isotope Program. Gaseous volumes in thousand cubic feet (Mcf)				

1.3.1 NASA and DLA Uses

Helium is used at all NASA Field Centers, as well as at NASA's Columbia Scientific Balloon Facility (CSBF) for their balloon campaigns in Antarctica and in the United States. NASA also supplies helium to several Air Force programs and other customers through reimbursable agreements, including the Delta IV/Atlas V/Space X launch programs, DLA-Energy, and Delta IV engine testing programs.

NASA helium is used in both gaseous and liquid form. Gaseous helium is used for purging of hydrogen systems, and as a pressurizing agent for ground and flight fluid systems of space vehicles. It is also used as a lifting gas for CSBF balloon operations. An important use of gaseous helium is for the purging of space vehicle engines that use liquid hydrogen for fuel. Past examples include the Space Shuttle Main Engines and the upper stage J-2 engines of the Saturn V launch vehicle. Current and future hydrogen fueled launch vehicles include the Delta IV and upcoming NASA Space Launch System (SLS). Other non-hydrogen fueled launch vehicles (e.g., Atlas V and Falcon 9) still use some helium for purges and system pressurization, but at lower quantities than hydrogen fueled launch vehicles. Liquid helium is used for safely cooling test articles and payloads to cryogenic temperatures (simulating liquid hydrogen temperatures) as well as to cool payload instrumentation. Helium has also been used at NASA as a lab analysis gas, a leak check gas and a weld gas.

DLA provides helium to DoD, Department of Homeland Security (DHS), Department of Energy (DOE), National Oceanic and Atmospheric Administration, commercial space launch companies (under the Commercial Space Launch Act), and some universities working under Federal grants. The helium is used for various applications including Aerostats and Airships used as intelligence, surveillance and reconnaissance platforms by DoD and DHS, Air Force and Army depot maintenance facilities, and DoD and Federal agency research and development laboratories. DLA also supplies helium for space launches by the Air Force, some NASA launches, and commercial space programs supported by United Launch Alliance, such as the Atlas V and Delta IV launch programs.

DLA helium is used in both gaseous and liquid form. The gaseous helium is used as a lifting gas in aerostats programs such as the Persistent Threat Detection System, the Tethered Aerostats Radar System, and weather research programs in weather balloons. In addition, the gaseous helium is used

in multiple programs for diverse applications to include reducing rocket sled friction at the Holloman High Speed Test Track, as a carrier gas during the cold spray process at Aberdeen Proving Grounds, as a carrier gas for analyses at multiple DoD laboratories, to pressurize and purge space launch vessels using hydrogen fuel, and as a breathing gas for deep sea divers in the Navy.

Liquid helium provided by DLA is used in Magnetic Resonance Imaging (MRI) at military hospitals, and Nuclear Magnetic Resonance applications in university laboratories. DLA also supplies liquid helium to several federally-funded, integral research programs at universities throughout the United States.

1.3.2 NASA and DLA Demand

During the height of the Space Shuttle Program, NASA helium use (including use by reimbursable customers) varied between 110 MMcf to 130 MMcf of helium per year. Use declined to around 85 MMcf per year toward the end of the Shuttle Program. Annual use continued to decline for several years following the end of the Shuttle Program to the current 55 MMcf to 60 MMcf per year. Gradual increases are expected as NASA develops the SLS Program, with the first SLS launch currently scheduled for late in 2018. Use over the next 5 years (FY 2015-2019) is expected to range from 72 MMcf to 87 MMcf of helium per year. Future NASA use may decrease with increased helium conservation efforts or development of future launch systems that do not use liquid hydrogen fuel.

From 2002 through 2008, DLA helium use averaged between 20 MMcf to 25 MMcf per year. Starting in 2009, DLA supported a steady increase to 45 MMcf to 50 MMcf per year attributed to an increase in aerostat programs in Afghanistan. During 2013 and 2014, use declined with the reduction of war efforts to today's level of 27 MMcf to 32 MMcf per year. Use over the next 5 years (FY 2015-2019) is expected to increase slightly from 30 MMcf to 35 MMcf per year with the increased usage of aerostats by DHS for border patrol and drug interdiction efforts, and due to the re-introduction of aerostats in Iraq.

1.3.3 Other Federal Uses/Demands

The DOE's Isotope Program conducts annual isotope demand surveys of Federal agencies. Early in FY 2015, DOE's information request included 10-year projections for gaseous and liquid helium demand from major Federal users (Table 2). This included agencies of the DoD, NASA, other Federal agencies and their program offices.

DOE's resulting demand data indicates that trends in the BLM's In-Kind sales history are likely to continue for the next 10 years. Reporting agencies estimated FY 2015 demand totaling 154 MMcf feet. The range in estimated demand for FY 2016 through FY 2025 is 136 to 149 MMcf annually.

The DoD and NASA account for approximately 77 percent of the 10-year demand estimates. All other Federal agencies combined account for 23 percent of the demand.

1.4 United States and World Production

Ten plants (five in Kansas, four in Texas, and one in Wyoming) extracted helium from natural gas and produced a crude helium product that varied from 50 percent to 99 percent helium. Three plants (one in Colorado, one in Utah, and one in Wyoming) extracted helium from natural gas and produced a high purity helium product (99.995 percent or greater). Six plants (four in Kansas, one in Oklahoma, and one in Texas) accepted a crude helium product from other producers and the BLM pipeline and purified it to a high purity helium product.

The helium extracted from natural gas during FY 2014 was estimated at 2,630 MMcf, and approximately 1,080 MMcf of additional helium was withdrawn from the Federal Helium Reserve. About 2,490 MMcf of the above production was exported and 1,220 MMcf was consumed domestically.

By the end of the decade, international helium extraction facilities are likely to become the main source of supply for world helium users. Seven international helium plants are in operation and more are planned for the next 3 to 5 years. Expansions to extraction facilities have been completed as planned in Algeria and Qatar. In 2014, demand for helium worldwide increased, but domestic demand decreased. Additionally in 2014, new domestic production began in Wyoming and more production is started in southwest Colorado in 2015. As a result, demand for the government's helium production has decreased by 50 percent over the past 2 years. Table 3 shows the estimated worldwide production of helium.

Table 3 –World Production estimates

Volumes in MMcf @14.7 psi and 70° F	2013	2014
US (extracted from natural gas)	2490	2630
US (from Cliffside Field)	1770	1080
Algeria	600	900
Australia	200	200
Poland	100	100
Qatar	900	1400
Russia	200	190
World total (rounded)	6260	6490

2 Twenty-Year Federal Acquisition Strategy

The HSA requires the BLM to sell and dispose of all helium-related assets by 2021. When that occurs, Federal users will have to find new sources other than the Federal Helium reserve and the In-Kind program to meet their helium needs. The acquisition strategy for Federal agencies consists of five parts: 1) Promulgating regulations to begin a Royalty-In-Kind program from helium extracted on Federal lands; 2) Exploring the Federal Strategic Sourcing Initiative as part of the Interagency

Working Group to fully supply all Federal agencies and intramural contract holders; 3) Providing funding for research and development efforts for conservation, recycling, and recapturing of helium; 4) Conducting economic evaluations of options to continue the helium program beyond 2021; and 5) Establishing an interagency working group to monitor and coordinate implementation of the above strategies and suggest changes as the helium market evolves.

2.1 Royalty-In-Kind

The BLM receives cash royalties from refiners extracting helium from Federal lands through contracts with extractors and refiners. Regulations could be promulgated to allow Federal users to satisfy their helium requirements from refiners extracting helium from Federal lands.

The amount of helium extracted from Federal lands is about 1.4 Bcf per year. Most of this extraction comes from one facility in southwest Wyoming. A new extraction facility in southwest Wyoming is expected to come online by FY 2016 and will initially produce about 0.2 Bcf per year of additional helium. Its full production rate is expected to be 0.4 Bcf per year by 2018. Helium production from southwest Wyoming is expected to remain nearly constant over the forecast period because the reservoir is still in the early stage of its projected productive life.

The BLM collected about \$15 million in helium fees and royalties (equivalent to about 120 MMcf of helium) in FY 2014. The BLM forecasts the royalty volume to increase to about 160 MMcf per year by 2018, and to remain steady thereafter for the remainder of the forecast period. The net effect on individual agency budgets of this option is positive because the royalty dollars are being exchanged for helium that would have been budgeted to purchase helium at higher market prices by the Federal agencies. This option will require regulatory change and amending contracts with refiners extracting helium from Federal lands; but the benefit of this strategy is that Federal agencies will have an assured source of helium well into the future. However, if Federal demand increases, the amount of Royalty-In-Kind helium may not meet the Federal demand.

2.2 Federal Strategic Sourcing

The Federal Strategic Sourcing Initiative could be explored as part of the Interagency Working Group to fully supply all Federal agencies and intramural contract holders. Through this program, a high-volume helium user, such as DLA or NASA, could procure helium for Federal users based on economic benefit to the agencies. These users would submit their helium requirements to the procuring agency, and that agency would use its buying power to achieve better pricing and efficiencies for the smaller Federal users.

The budgetary impact of this portion of the strategy is positive because small users could achieve savings through economies of scale. Additionally, the small users would be assured a steady supply at a known price, allowing them to more accurately estimate research costs.

2.3 Conservation, Recycling, Reuse

A necessary part of the strategy is to reduce Federal helium usage. The agencies could sponsor purchase of recovery units for extramural research and laboratory recovery. NASA could focus on new rocket designs that require less helium for purging and develop recovery systems to capture helium to be purified for reuse. One agency, the Division of Materials Research within the National Science Foundation (NSF), has allocated \$1 million per year to qualifying NSF grantees for the purchase of helium recovery units.

Section 17(3)(A) of the HSA charters the DOE with the following: *“to develop low-cost technologies and technology systems for recycling, reprocessing, and reusing helium for all medical, scientific, industrial, commercial, aerospace, and other uses of helium in the United States, including Federal uses.”* The HSA authorizes up to \$3 million to be used for programs under Section 17. At present, programs within existing appropriations address advanced manufacturing of helium gas separation technologies. Also, included in budget requests for both FY 2015 and FY 2016 for the DOE Advanced Manufacturing Office are line items specifically focused on development of enhanced gas extraction technology programs.

Continued actions on programs supporting implementation of Section 17(3)(A) serving to enhance helium manufacturing efficiencies and capture will require additional appropriations. Implementation of developed innovations in materials and manufacturing process will contribute to the overall supply chain, which will impact helium availability for both Federal and private industry use. Introduction of technologies that have only minimal impact on annual Federal needs result in a modest cost savings. At current consumption rates, each percent of Federal agency use represents about 1.5 MMcf or \$150 thousand. Any resultant savings and/or licensing fees from technology advancements could be used to fund continuing research and implementation of the conservation program.

2.4 Conduct Economic Evaluations of Options to Continue the Federal Helium Program

The team discussed and evaluated three options to continue the Federal Helium Program. However, each option would require the BLM or another designated agency to retain assets associated with the Federal Helium System beyond the 2021 Phase D date currently stated in the HSA, and would therefore require new legislation. The BLM recommends a complete economic evaluation of each option. These evaluations will guide discussions regarding any future legislation. The three options are: 1) Retool the Crude Helium Enrichment Unit (CHEU), 2) Process helium from Cliffside Field at a nearby crude helium plant, and 3) Construct a purification plant at Cliffside Field for Federal needs. Each of these options is discussed in greater detail in Appendix I.

2.5 Interagency Working Group

The team proposes an interagency working group that functions similar to the He-3 Inter Agency Group led by the DOE Isotope Program and sponsored by White House National Security Staff. This group would meet at least annually and continue to work on assessing and refining the 20-year strategy. It would also be responsible for recommending the prioritization of uses during times of shortage or supply interruptions. The group would also keep abreast of the Federal and commercial helium industry and market.

3 Determination of Date Prior to September 30, 2021 for Phase D

The HSA requires the BLM to annually offer for auction and sale helium volumes equal to productive capacity of the Federal Helium Reserve. Current maximum production projections show that the recoverable, Federally-owned helium in the Cliffside Field will reach 3.0 Bcf on October 1, 2019, after the helium sold at the final auction/sale is transferred to private ownership. Phase C begins when the Federal Helium Reserve declines to 3.0 Bcf, and lasts a minimum of two years. Therefore, according to current projections, Phase D can begin no earlier than September 30, 2021.

4 Assessment of the Effects of Increases in the Price of Refined Helium and Mitigation Strategies

Under the HSA, the BLM is required to sell helium from the Federal Reserve to private entities at market-based prices determined by industry surveys and the Phase B auctions. Currently, the In-Kind price is calculated at a discount from the sales and auction prices. Although all price projections are uncertain, the BLM expects the price of crude and refined helium to continue to increase for Federal agencies.

The effect of the price increases for Federal agencies will be requests for additional funds for procuring helium. If budgets continue to be constrained, then helium requirements will be either funded from other programs or the programs using helium will be delayed or cut. This could lead to critical research not being performed, defense and homeland security uses being cut back, and planned aerospace programs being delayed.

The 20-year strategy discussed in Section 2 would help to mitigate these impacts because the Royalty-In-Kind program assures helium availability to Federal users without additional appropriations. The disadvantage is that the collection of royalty dollars from refiners extracting helium from Federal lands will cease and less money will go to the Treasury. Additionally, as part of the 20-year strategy, agencies are expected to develop conservation and recycling methods that will decrease demand for “new” helium.

5 Prioritization of Uses

The BLM believes the 20-year strategy also mitigates the effects on Federal agencies of potential higher prices for refined helium in the private market and deflects the immediate need for prioritization of helium uses. As discussed in Section 2.5, the BLM recommends establishing an interagency working group to continuously assess Federal helium needs, update estimates of helium demand and projections, and provide a process for prioritization of uses when necessary.

Appendix I Other Options and Strategies

1 Retool the Crude Helium Enrichment Unit (CHEU)

The CHEU could be retooled for lower flow rates and helium production. The enriched helium would then be sent through the Federal Helium Pipeline (FHP) for refining by a private refiner. As constructed, the CHEU's lowest feed gas rate is about 16 MMcf/day. By 2021, the Cliffside Field will be unable to supply enough feed gas to maintain operation. Further study is needed to determine what changes to the process or what mechanical revisions are needed to keep the CHEU operating beyond 2021 and evaluate the projected costs of the retooling, including longer-term operation and maintenance costs. Implementation of this option requires the BLM (or other designated agency) to keep the assets associated with the Federal Helium System.

The potential benefits from this option include lower costs to Federal users for helium and an assured supply of prioritized helium for the remaining life of the Cliffside Field, which is expected to be 30 years or more at Federal helium demand rates after 2021. The BLM is allowed by the HSA to charge Federal users an amount equal to its costs during Phase C [50 U.S.C. §§ 167d(c)(1)] and it is assumed similar charges would apply to helium produced from a retooled CHEU.

A disadvantage to this option is the continued reliance on the helium refiners along the FHP. The BLM projects these refiners will cease helium production during the next decade; therefore, one of the other options would be required by the end of the next decade. Additionally, the CHEU was constructed in 2003 and will incur increasing maintenance and operation costs as the equipment ages further.

2 Process helium from Cliffside Field at a nearby crude helium plant

Alternatively, the production from Bush Dome could be sent to a nearby private helium extraction plant for enrichment and later delivery to a refiner along the FHP. The infrastructure for this alternative is mostly in place; therefore, the only additional funds required would be for expansion. However, depending on which extraction plant is awarded the contract, 10 to 20 miles of additional pipeline may be needed. Implementation of this option would require the BLM (or other designated agency) to retain the assets associated with the Federal Helium System. Further study of the benefits and costs is needed to fully evaluate this option.

The potential benefits from this option are similar to option 1 (Retooled CHEU) and will not be repeated here. As with the option 1, a disadvantage to this option is the continued reliance on the helium refiners along the FHP. This option has an additional disadvantage in that the Federal users would also rely on the continued operation of a private helium extraction plant. The BLM expects these plants to close during the next decade, and there may also be substantial added costs for construction of a lateral line to a private helium extractor. Total costs for pipeline construction,

including rights-of-way acquisition, are currently estimated to be from \$1 million to \$2 million per mile. These costs would likely be borne by the extraction plant and passed on to the Federal users through processing fees.

3 Construct purification plant at Cliffside Field for Federal needs.

The final alternative is to construct a small helium purification plant at the Federal Helium Reserve that continues producing and processing gas from the Bush Dome. The plant would be government-owned and contractor-operated (GOCO) and maintained. Implementation of this option would require the BLM (or another designated agency) to retain the assets associated with the Federal Helium System. The funding for this alternative could come from excess funds remaining in the Helium Production Fund at the end of the program or from the revenues generated from sales. An initial estimate of the investment in a small helium refinery is in the range of \$20 million to \$30 million with annual operation and maintenance costs of \$5 million to \$15 million. A complete evaluation of this option is needed to fully analyze the benefits and costs.

The greatest potential benefit to this option is that Federal users will have complete control over the supply and cost of helium for the long term. Using the above range of costs, with a 20-year life, and Federal demand of 150 Mcf/yr to 200 Mcf/yr, the cost of helium to Federal users would range from about \$40 to \$110 per Mcf of pure helium. Additionally, because this plant would be operated as a traditional GOCO, the BLM or another designated agency would only need a small support staff to oversee the contract and operations.

A disadvantage to this option is that some Federal users would still need to contract for transportation of the refined helium or purchase their own transportation devices and containers.

Appendix II– History of Helium Program and Helium Supply Projections

1 History

Helium is present in at least trace quantities in most natural gases. The large Hugoton gas field of Kansas, Oklahoma and the Texas Panhandle contains helium in large enough percentages (~0.5 percent) to make extraction economical. Because the helium in the natural gas was being lost as the gas was produced, Congress, at the urging of many in the scientific community, passed the Helium Act of 1960. The Act authorized the United States Bureau of Mines (BOM) to purchase helium and store it for future use, which is commonly referred to as the Helium Conservation Program. Over the next decade, approximately 35 billion cubic feet (Bcf) of helium was purchased and stored underground in the partially depleted Cliffside Field – often referred to by its geologic structure known as the Bush Dome. This crude helium was refined by the BOM for sale and distribution to government users. The helium is stored in a dolomite formation with about 10 percent porosity and 800 psi of original reservoir pressure. The concentration of the helium that has been stored was about 70 to 75 percent with the remainder mostly nitrogen. This concentration is known as crude helium. Over time the helium has mixed with the native gas and is present in various concentrations in the field.

By 1973, with the National Aeronautic and Space Administration's (NASA) Apollo space program at an end and the government needing much less helium than forecasted, the helium purchase contracts with the private extractors were canceled, which led to several years of litigation during which most private helium extraction plants remained idle. Over the next 20 years, the Cliffside Gas Field was normally in the injection mode during the winter months when the demand for natural gas is high and private plants produced excess crude helium, which was injected into and stored in the reservoir. When the natural gas demand dropped in the summer, the supply of helium decreased, resulting in the need for crude helium to be produced out of the storage reservoir to meet market demand. By 1995, the Helium Program owed over \$1 billion to the Treasury in principal and interest on funds borrowed during the conservation program. Helium extraction from the Hugoton Field was decreasing and private refiners saw a need for additional supplies of crude helium for commercial use. Many in government and industry saw a need to change the mission of the program.

In 1996, Congress passed the Helium Privatization Act (HPA), which authorized the cessation of the government's helium refining capabilities, the sell-off of the conservation helium in storage, continued operation of the storage and transportation of crude helium, and continued evaluation of the Nation's helium resources. The HPA required Federal agencies to purchase their major helium requirements from a "qualified Federal helium supplier," who, in turn, purchased the same amount from the conservation helium in storage. This is commonly referred to as the "In-Kind" program.

Other legislation shut down the BOM and transferred the Federal Helium Pipeline (FHP) to the BLM.

From the date of passage of the HPA through the end of FY 2013, the BLM operated the FHP with a primary goal of paying off the “helium debt.” To this end, the BLM completed payment of the helium debt (the HPA froze at approximately \$1.37 billion) at the beginning of FY 2014.

According to the HPA, once the helium debt was retired, the Helium Production Fund (used to fund the BLM’s helium program operational expenses) would be dissolved and all future receipts would be deposited directly into the general fund of the United States Treasury.

2 Federal and Private Helium Supply Projections

2.1 From the Federal Helium Reserve

The BLM Cliffside Field (Bush Dome) is a depleting natural gas reservoir, which contains the Nation’s Federal Helium Reserve. The global helium industry turns to the Cliffside Field to make up the difference between worldwide helium supply and demand. As recently as 2012, the Federal Helium Reserve accounted for nearly 45 percent of the Nation’s helium production and 33 percent of the World’s production. As of September 30, 2014, the helium remaining in the reserve was 9.65 Bcf of total storage; of that amount, 7.82 Bcf was Federal helium. The HSA mandated that sales from the Federal Reserve be equal to the productive capacity of the Federal Reserve less the In-Kind helium transfers. The productive capacity of the Reserve is decreasing at an annual rate of about 12 percent. Current projections show that the recoverable, Federally-owned helium in the Cliffside Field may reach 3.0 Bcf by October 1, 2019. Phase C begins when the Federal Helium Reserve declines to 3.0 Bcf, and lasts a minimum of two years. Therefore, according to current projections, Phase D can begin no earlier than September 30, 2021. The Introduction of this Report and Title 50 USC § 167d provide descriptions of the phases. Table 4 shows the current drawdown and sales estimates based on NITEC LLC reservoir engineering estimates.

Table 4 – Forecasted production and sales

Fiscal Year (FY)	Forecasted Production Capability (NITEC LLC Study)	In-Kind Sales	Total Production Available for Sale/Auction/Delivery	FY 2016 Advanced Sale (conducted in FY 2014)	Volume Available for Auction	Volume available for Sale
	MMcf	MMcf	MMcf	MMcf	MMcf	MMcf
FY2016	1,310	160	1,150	250	300	600
FY2017*	1,060	160	900	0	360	540
FY2018*	880	160	720	0	400	320
FY2019*	740	160	580	0	410	170
FY2020*	610	160	450	0	450	0

FY2021*	510	160	350	0	450	0
* Delivery for FY16 – FY21 sales and auctions are projected volumes subject to change						

2.2 Federally-Owned Helium

In addition to the Federal Helium Reserve, the BLM manages all helium contained in gas reserves on Federal land. Before helium can be extracted from Federal natural gas reserves, the entity desiring to extract helium must enter into a contract with the BLM and pay royalties on the extracted helium. The BLM collected about \$15 million in helium fees and royalties in FY 2014.

The amount of helium extracted annually from Federal lands is about 1.4 Bcf per year. Most of this extraction comes from one facility in southwest Wyoming. A new extraction facility in southwest Wyoming is expected to come online by FY 2016 and will initially produce about 0.2 Bcf per year of additional helium. Its full production rate is expected to be about 0.4 Bcf per year by 2018. Helium production from southwest Wyoming is expected to remain nearly constant over the forecast period because the reservoir is still in the early stage of its projected productive life.

After the end of the productive life of the Federal Helium Reserve, the Federally-owned helium could be a source of helium for Federal users through contracts or Royalty-In-Kind arrangements as discussed in Section 2 – Twenty Year Federal Acquisition Strategy.

2.3 Private Domestic Helium

Since the late 1980s, the domestic private helium production has been mostly from two regions: southwest Wyoming and the Midcontinent area of Kansas, Oklahoma, and Texas. As mentioned in the Federally-owned helium section, production from southwest Wyoming is expected to remain stable for the next 20 to 30 years. However, production from the Midcontinent area is declining at about 7 to 10 percent per year. In FY 2014, the Midcontinent area produced about 1.0 Bcf of helium, not including production from the Federal Helium Reserve.

Eight plants (three in Kansas, four in Texas, and one in Wyoming) extracted helium from natural gas and produced only a crude helium product that varied from 50 percent to 99 percent helium. Three plants (one in Colorado, one in Utah and one in Wyoming) extracted helium from natural gas and produced a high purity helium product. Five plants, (four in Kansas, and one in Oklahoma) accepted a crude helium product from other producers as well as the conservation helium sold to private entities as part of the HPA sell-off and purified it to a high-purity helium product. Estimated 2014 domestic consumption of helium is 1.2 Bcf. As the Midcontinent and Cliffside Field gas reserves decline, individual plants will shut down and there will be some consolidation of extraction and purification. By the middle of the next decade, extraction in the Midcontinent area will be less than 0.5 Bcf and may have ceased entirely because of economic considerations. The following table depicts the salient statistics for domestic helium in the United States for the past five years.

Table 5 – Domestic Helium in the United States: 2009-2013

	2010	2011	2012	2013	2014
Helium extracted from natural gas ^{1,2}	2.7	2.6	2.6	2.6	2.6
Withdrawn from storage ³	1.9	2.1	2.2	1.8	1.1
High purity helium sales	4.6	4.7	4.8	4.4	3.7
Imports for consumption	0	0	0	0	0
Exports ⁴	2.8	3.0	3.1	3.0	2.5
Consumption, apparent ⁵	1.8	1.7	1.7	1.4	1.2

¹Measured at 70° F and 14.7 psia. ²Both high purity and crude helium.

³Extracted from natural gas in prior years.

⁴High-purity helium. ⁵Defined as imports – exports + adjustments for Government and industry stock changes.

Appendix III– Acronyms Used in this Report

Bcf	Billion cubic feet
Mcf	Thousand cubic feet
MMcf	Million cubic feet
CHEU	Crude Helium Enrichment Unit
FHP	Federal Helium Pipeline
FHR	Federal Helium Reserve
GOCO	Government-owned and Contractor-operated
HPA	Helium Privatization Act of 1966
HSA	Helium Stewardship Act of 2013 and 50 U.S.C. §§ 167q
BLM	United States Department of the Interior, Bureau of Land Management
BOM	United States Department of the Interior, Bureau of Mines
DHS	United States Department of Homeland Security
DLA	United States Defense Logistics Agency
DoD	United States Department of Defense
DOE	United States Department of Energy
DOI	United States Department of the Interior
NASA	National Aeronautics and Space Administration
NIH	United States Department of Health & Human Services, National Institutes of Health
NIST	United States Department of Commerce, National Institute of Standards and Technology
NSF	National Science Foundation
OSTP	United States Executive Office of the President, Office of Science and Technology Policy
SLS	NASA Space Launch System
USGS	United States Department of the Interior, United States Geological Survey